00-140

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant:	May, Bhatt
Serial Number:	09/670,975
Filed:	2000.09.27
Title:	Temperature Control System
Examiner:	Erik J. Kielin
Group Art Unit:	2813
Attorney Docket:	00-140

APPLICANTS' BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O Box 1450
Alexandria VA 22313-1450

Via Fax at 1.703.872.9306

Sir:

Pursuant to 37 C.F.R., 1.191, applicants hereby submit this brief on appeal from the examiner's final rejection of 2004.10.26 of claims 1-5 and 7-8. This brief is filed via fax in support of the notice of appeal filed via fax on 2004.12.01. Only one copy of this brief is filed, as the USPTO now receives faxes electronically, and can electronically generate as many copies as desired. However, applicants can fax multiple copies if they are desired. The Commissioner is authorized to charge the $500 fee associated with the filing of this brief, and any other fees required such as extensions of time, to the LSI Logic Corporation deposit account number 12-2252.

I hereby certify that this correspondence is being transmitted by facsimile to the Patent and Trademark Office in accordance with § 1.6(d) to the number above on the date below.

2005.01.31
Date

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I. Real Party In Interest

The real party in interest is LSI Logic Corporation, a corporation of Delaware, and assignee of record of the entire right, title, and interest in and to the invention and application for patent thereon from the inventor Edwin M. Fulcher.

II. Related Appeals And Interferences

There are no related appeals or interferences.

III. Status Of Claims

Claims 1-5 and 7-20 are in the case. Claims 9-20 are withdrawn from consideration. Claims 1-5 and 7-8 are rejected under 35 USC § 102 over USPN 5,591,269 to Arami et al. Claims 1, 3-4, and 7-8 are rejected under 35 USC § 102 over USPN 5,435,379 to Moslehi et al. Claims 1-3, 5, and 7-8 are rejected under 35 USC § 103 over Muller et al. in view of Arami et al. The claims on appeal are claims 1-5 and 7-8, as given in the Appendix.

IV. Status Of Amendments

All amendments have been entered in the case.

V. Summary Of The Invention

A general summary of the art is first provided in this section, followed with a specific summary of the invention as claimed.

During the fabrication of integrated circuits, various processes are performed on the substrates in which the circuits are formed. These processes are typically accomplished within reaction vessels. The exact reaction that takes place on the substrate as it is processed in a given reaction vessel is typically a function of several different variables, including such things as the type and flow rate of process gases, the pressure within the reaction vessel, the process energy that is applied, and the temperature of the substrate. If any one of these (or other) variables drifts outside of a desired range during

processing of the substrate, then the reaction kinetics at the substrate are altered, and the process may not achieve the desired result.

Therefore, maintaining these variables within specific ranges is of the utmost importance. These variables are controlled in a variety of different ways, depending upon the specific variable that is to be controlled. For example, the pressure of the reaction vessel is typically sensed by a pressure gauge on the vessel, which gauge reports the pressure to a controller. The controller then adjusts the outlet valving of the vessel as required to maintain the desired pressure. Similarly, process energy is typically sensed by electronics that report to the same or a different controller. The controller then adjusts the power supply for the process power as needed to maintain the desired process energy. Process energy includes elements such as the power applied to create a plasma within the reaction vessel.

The embodiments of the invention described in the present application generally relate to monitoring and controlling another of the process variables: the temperature of the substrate. As claimed, the temperature of the substrate is controlled by sensing and controlling the temperature of the chuck on which the substrate is disposed. A controller is used to make the adjustments as described in the claims, which controller could be the same or a different controller as that which independently maintains the other processing variables.

In brief, many variables are preferably controlled during the processing of a substrate, and this invention relates to controlling one of those variables, which is the substrate temperature.

The summary of the invention is now provided with reference to claim 1. References to the text of the specification are made parenthetically, in the following manner (Spec. Page:Lines). References to the figures are also made parenthetically, in the following manner (Fig. Number:Element).

A method for controlling a substrate temperature of a substrate (Fig. 1:38) during processing of the substrate at a process energy, by controlling with a controller (Fig. 1:12) a chuck temperature of a chuck (Fig. 1:32) on which the substrate resides during the processing, comprising circulating under control of the controller a thermal transfer media at a thermal transfer media temperature through the substrate chuck to adjust both

the chuck temperature and the substrate temperature (Spec. 8:6-19), the thermal transfer media circulating at a flow rate, sensing the chuck temperature from at least one chuck temperature sensor (Fig. 1:40) in the chuck, reporting the sensed chuck temperature to the controller (Spec. 6:12-13 and 9:12-13), where the controller is adapted to adjust the process energy, the thermal transfer media flow rate, and the thermal transfer media temperature (Spec. 9:4-11, 15-24), and when the sensed chuck temperature is outside of a desired temperature range, then using the controller to bring the sensed chuck temperature within the desired temperature range, by sequentially adjusting a first one of the thermal transfer media temperature and the thermal transfer media flow rate (Spec. 10:9-15), checking the sensed chuck temperature to determine whether it is within the desired temperature range, and taking no further immediate action to control the substrate temperature if the sensed chuck temperature is within the desired temperature range, if the sensed chuck temperature is not within the desired temperature range after adjusting the one of the thermal transfer media temperature and the thermal transfer media flow rate, then adjusting a second one of the thermal transfer media temperature and the thermal transfer media flow rate that has not been previously adjusted, checking the sensed chuck temperature to determine whether it is within the desired temperature range, and taking no further immediate action to control the substrate temperature if the sensed chuck temperature is within the desired temperature range, if the sensed chuck temperature is not within the desired temperature range after adjusting both the thermal transfer media temperature and the thermal transfer media flow rate, then adjusting the process energy until the sensed chuck temperature is within the desired temperature range (Spec. 10:26-11:2).

VI. ISSUES

(A) Whether claims 1-5 and 7-8 are patentable under 35 USC § 102 over USPN 5,591,269 to Arami et al.

(B) Whether claims 1, 3-4, and 7-8 are patentable under 35 USC § 102 over USPN 5,435,379 to Moslehi et al.

(C) Whether claims 1-3, 5, and 7-8 are patentable under 35 USC § 103 over Muller et al. in view of Arami et al.

VII. GROUPING OF CLAIMS

Appellants do not at this time assert that the claims on appeal do not stand or fall together. Accordingly, and for purposes of this appeal only, appellants suggest that the Appeal Board decide the appeal as to the grounds of rejection on the basis of claim 1 alone.

VIII. ARGUMENTS

(I)-(II) There are no rejections falling under these sections.

(III) PRELIMINARY COMMENTS ON REJECTIONS

One area of disagreement between the examiner and the applicants is the definition for the phrase "process energy," which phrase is used in the claims. The examiner asserts that the phrase is to be given its broadest definition according to the common meaning of the individual words. The applicants assert that the phrase is to be interpreted in light of its usage in the specification. These two differing viewpoints result in a difference in the scope of the claims, where the examiner asserts that "process energy" includes block heaters that are disposed in a chuck, as described in one of the cited references. The examiner bases his interpretation on a litany of case law, which states that limitations from the specification cannot be read into the claims.

Applicants agree that limitations from the specification are not to be read in to the claims. Thus, applicants' position does not dispute the case law cited by the examiner in any way. However, applicants assert that the terms used in the claims are defined by their usage in the specification. In other words, if a claim recites three different elements, but those three elements and seven others are described in the specification, it is proper to not read any one or more of the additional seven elements into the claim. However, descriptions of the three claimed elements as derived from their usage in the specification are properly taken into account when determining the scope of the claim.

In the present case, applicants describe "process energy" at various points in the specification. For example, "the energy for the process" is described in the first full paragraph on page six of the specification, as emitting from an emitter 42 "such as a

sputter target." The emitter 42 is depicted at the top of the reaction chamber 44. The first paragraph on page nine describes connecting the emitter to the controller through a "process energy" output. It is evident that "process energy," as used in this application – including the claims – is limited to a specific kind of energy that is used in the process. Conversely, the specification also describes heater blocks that are optionally included in a chuck, such as in the second full paragraph on page eight. The heater blocks as described are completely separate from any of the elements or description of process energy.

It is evident from these separate and distinct descriptions in regard to "process energy" and the heater blocks, that the energy delivered through the heater blocks is not a part of process energy, as the terms are used in the specification. It is proper to apply this exclusion to the term "process energy" as used in the claims. Thus, "process energy" as used in the claims does not include energy that is delivered through the heater blocks. Therefore, the examiner's assertion that "process energy" includes the energy delivered through a heater block is in error.

(A) Whether claims 1-5 and 7-8 are patentable under 35 USC § 102 over USPN 5,591,269 to Arami et al.

Independent claim 1 claims, *inter alia,* a method for controlling the temperature of a substrate with a controller adapted to adjust the process energy, the media flow rate, and the media temperature, by ***sequentially*** adjusting, ***a first one of the media temperature and the media flow rate***, if the chuck temperature is not within the desired temperature range, then adjusting ***a second one of the media temperature and the media flow rate*** that has not been previously adjusted, if the chuck temperature is still not within the desired temperature range, ***then adjusting the process energy*** until the chuck temperature is within the desired temperature range.

Thus, claim 1 requires several limitations as a part of the method. First, it requires the use of a controller that is adapted to control at least three different things, being the process energy, the media flow rate, and the media temperature. Thus, if a method does not use such a controller to control the temperature of the substrate, then the present method as claimed does not read on that method. Further, if a method uses a controller to control the temperature of a substrate, but the controller is not adapted to

control the process energy, the media flow rate, and the media temperature, then the present method as claimed does not read on that method. Second, claim 1, as a method claim, requires that the controller operates to control the temperature by taking specific actions in a specific sequential order. If a method does not take these same actions, or performs them in a different order, then the present method as claimed does not read on that method.

Applicants note that while a specific instance of the use of the method of claim 1 may not require that all of the media temperature, media flow rate, and process power be adjusted to control a temperature excursion, the method as claimed nonetheless requires the capacity to do all three. Further, the method as claimed requires the use of a controller that is adapted to accomplish all three sub methods of temperature control.

Arami et al. do not describe such a method. Specifically, Arami et al. do not describe a method that uses a controller that is adapted to control all three of the process energy, the media flow rate, and the media temperature. Arami et al. do not adjust the temperature of the coolant, and neither do Arami et al. adjust the process power. It is noted that the references to adjusting power in Arami et al. are in regard to the power supplied to the heater blocks 130, 131, and 132, which have nothing to do with the processing power. Further, Arami et al. do not describe first adjusting the temperature and flow rate of the media, and then only if that doesn't work to control the temperature by adjusting the process energy. Thus, the method described by Arami et al. is different from the method as claimed in claim 1.

Therefore, claim 1 patentably defines over Arami et al. and the rejection is in error. Dependent claims 2-5 and 7-8 depend from independent claim 1, and contain additional important aspects of the invention. Therefore, dependent claims 2-5 and 7-8 patentably define over Arami et al. and the rejections are in error. Applicants respectfully request that claims 1-5 and 7-8 be allowed and the rejections to these claims reversed.

(B) WHETHER CLAIMS 1, 3-4, AND 7-8 ARE PATENTABLE UNDER 35 USC § 102 OVER USPN 5,435,379 TO MOSLEHI ET AL.

Claims 1, 3-4, and 7-8 are rejected under 35 USC § 102 over Moslehi et al. Independent claim 1 claims, *inter alia,* a method for controlling the temperature of a

substrate with a controller adapted to adjust the process energy, the media flow rate, and the media temperature, by ***sequentially*** adjusting, ***a first one of the media temperature and the media flow rate***, if the chuck temperature is not within the desired temperature range, then adjusting ***a second one of the media temperature and the media flow rate*** that has not been previously adjusted, if the chuck temperature is still not within the desired temperature range, ***then adjusting the process energy*** until the chuck temperature is within the desired temperature range.

Moslehi et al. do not describe such a method. Specifically, Moslehi et al. do not describe a method that uses a controller that is adapted to control all three of the process energy, the media flow rate, and the media temperature. Moslehi et al. do not adjust the flow rate of the chuck coolant, and neither do Moslehi et al. adjust the process power. Moslehi et al. do not describe first adjusting the temperature and flow rate of the media, and then only if that doesn't work to control the temperature by adjusting the process energy. Thus, the method described by Moslehi et al. is different from the method as claimed in claim 1.

Therefore, claim 1 patentably defines over Moslehi et al. and the rejection is in error. Dependent claims 3-4 and 7-8 depend from independent claim 1, and contain additional important aspects of the invention. Therefore, dependent claims 3-4 and 7-8 patentably define over Moslehi et al. and the rejections are in error. Applicants respectfully request that claims 1, 3-4, and 7-8 be allowed and the rejections to these claims reversed.

(IV) 35 USC § 103 REJECTIONS

WHETHER CLAIMS 1-3, 5, AND 7-8 ARE PATENTABLE UNDER 35 USC § 103 OVER MULLER ET AL. IN VIEW OF ARAMI ET AL.

Claims 1-3, 5, and 7-8 are rejected under 35 U.S.C. 103 as being unpatentable over Muller et al. in view of Arami et al. Independent claim 1 claims, *inter alia*, a method for controlling the temperature of a substrate with a controller adapted to adjust the process energy, the media flow rate, and the media temperature, by ***sequentially*** adjusting, ***a first one of the media temperature and the media flow rate***, if the chuck

temperature is not within the desired temperature range, then adjusting ***a second one of the media temperature and the media flow rate*** that has not been previously adjusted, if the chuck temperature is still not within the desired temperature range, ***then adjusting the process energy*** until the chuck temperature is within the desired temperature range.

Muller et al. do not describe such a method. Specifically, Muller et al. do not describe a method that uses a controller that is adapted to control all three of the process energy, the media flow rate, and the media temperature. Muller et al. do not adjust the flow rate of the chuck coolant to adjust the temperature of the chuck. Further, Muller et al. do not describe first adjusting the temperature and flow rate of the media that is used to cool the chuck in order to control the temperature of the substrate, and then only if that doesn't work to control the temperature by adjusting the process energy. It is specifically noted that Muller et al. have no description whatsoever of combining any of the temperature control methods. Even in the claims, Muller et al. do not describe combining the temperature control methods in any way. Thus, Muller et al. do not describe any combination of temperature control methods, let alone the novel combination and order of temperature control methods as described in claim 1. For this reason, any argument based on Muller et al. as to the order of use of the temperature control methods being obvious is moot, because Muller et al. do not even use an order of temperature control methods. Instead, Muller et al. describe the separate and isolated use of alternate temperature control methods. Therefore, the method described by Muller et al. is different from the method as claimed in claim 1.

Arami et al. do not remedy the deficiencies of Muller et al. Specifically, Arami et al. do not describe a method that uses a controller that is adapted to control all three of the process energy, the media flow rate, and the media temperature. Arami et al. do not adjust the temperature of the chuck coolant to adjust the temperature of the chuck, neither do Arami et al. adjust the process power to adjust the temperature of the chuck. Further, Arami et al. do not describe first adjusting the temperature and flow rate of the media that is used to cool the chuck in order to control the temperature of the substrate, and then only if that doesn't work to control the temperature by adjusting the process energy. Thus, the method described by Arami et al. is different from the method as claimed in claim 1.

Therefore, the combination of Muller et al. and Arami et al. do not describe the method as claimed in claim 1, and claim 1 patentably defines over Muller et al. in view of Arami et al. and the rejection is in error. Dependent claims 2-3, 5, and 7-8 depend from independent claim 1, and contain additional important aspects of the invention. Therefore, dependent claims 2-3, 5, and 7-8 patentably define over Muller et al. in view of Arami et al. and the rejections are in error. Applicants respectfully request that claims 1-3, 5, and 7-8 be allowed and the rejections to these claims reversed.

(V) There are no rejections falling under this section.

IX. CONCLUSION

In light of the deficiencies of the rejections described at length above, claims 1-5 and 7-8 should be allowed and the rejections to these claims reversed.

Sincerely,

LUEDEKA, NEELY & GRAHAM, P.C.

By:

Rick Barnes, 39,596

APPENDIX

1. (previously presented) A method for controlling a substrate temperature of a substrate during processing of the substrate at a process energy, by controlling with a controller a chuck temperature of a chuck on which the substrate resides during the processing, comprising:

circulating under control of the controller a thermal transfer media at a thermal transfer media temperature through the substrate chuck to adjust both the chuck temperature and the substrate temperature, the thermal transfer media circulating at a flow rate,

sensing the chuck temperature from at least one chuck temperature sensor in the chuck,

reporting the sensed chuck temperature to the controller, where the controller is adapted to adjust the process energy, the thermal transfer media flow rate, and the thermal transfer media temperature, and

when the sensed chuck temperature is outside of a desired temperature range, then using the controller to bring the sensed chuck temperature within the desired temperature range, by sequentially

adjusting a first one of the thermal transfer media temperature and the thermal transfer media flow rate,

checking the sensed chuck temperature to determine whether it is within the desired temperature range, and taking no further immediate action to control the substrate temperature if the sensed chuck temperature is within the desired temperature range,

if the sensed chuck temperature is not within the desired temperature range after adjusting the one of the thermal transfer media temperature and the thermal transfer media flow rate, then adjusting a second one of the thermal transfer media temperature and the thermal transfer media flow rate that has not been previously adjusted,

checking the sensed chuck temperature to determine whether it is within the desired temperature range, and taking no further immediate

action to control the substrate temperature if the sensed chuck temperature is within the desired temperature range,

if the sensed chuck temperature is not within the desired temperature range after adjusting both the thermal transfer media temperature and the thermal transfer media flow rate, then adjusting the process energy until the sensed chuck temperature is within the desired temperature range.

2. (previously presented) The method of claim 1 wherein the chuck temperature is sensed from three different sensors in the chuck.

3. (previously presented) The method of claim 1 wherein the chuck temperature sensor is disposed within the chuck.

4. (previously presented) The method of claim 1 wherein the chuck temperature sensor is disposed on a surface of the chuck adjacent the substrate.

5. (original) The method of claim 1 wherein the desired temperature range is between about fifty centigrade and about five hundred centigrade.

6. (cancelled)

7. (previously presented) The method of claim 1 wherein the controller adjusts the thermal transfer media flow rate prior to adjusting the thermal transfer media temperature.

8. (previously presented) The method of claim 1 wherein the controller adjusts the thermal transfer media flow rate after adjusting the thermal transfer media temperature.

9. (withdrawn) An apparatus for controlling a substrate temperature of a substrate during processing of the substrate at a process energy, comprising:

a chuck temperature input for receiving temperature measurements from temperature sensors at a substrate chuck,

a temperature set point input for receiving temperature set points, the temperature set points defining a range of temperatures within which the apparatus maintains the substrate temperature,

a chuck temperature controller output for sending control signals operable to selectively increase and decrease the chuck temperature to a chuck temperature controller,

a process energy output for sending control signals operable to selectively increase and decrease the process energy during the processing of the substrate, and

a controller for,

comparing the temperature measurements received from the temperature sensors at the substrate chuck through the chuck temperature input to the temperature set points received through the temperature set point input,

sending control signals through the chuck temperature controller output to the chuck temperature controller to selectively decrease the chuck temperature when the temperature measurements received from the temperature sensors at the substrate chuck are above the temperature set points, and

sending control signals through the process energy output to selectively decrease the process energy when the temperature measurements received from the temperature sensors at the substrate chuck are above the temperature set points.

10. (withdrawn) The apparatus of claim 9, wherein the controller is further operable for:

sending control signals through the chuck temperature controller output to the chuck temperature controller to selectively increase the chuck temperature when the temperature measurements received from the temperature sensors at the substrate chuck are below the temperature set points, and

sending control signals through the process energy output to selectively increase the process energy when the temperature measurements received from the temperature sensors at the substrate chuck are below the temperature set points.

11. (withdrawn) The apparatus of claim 9, wherein the controller first sends control signals through the chuck temperature controller output to control the chuck temperature, and only sends control signals through the process energy output when the chuck temperature cannot be sufficiently controlled by the chuck temperature controller.

12. (withdrawn) The apparatus of claim 9, wherein the control signals sent by the controller through the chuck temperature controller output further comprise:

a thermal transfer media flow control signal for controlling a flow of a thermal transfer media through the chuck, and

a thermal transfer media temperature control signal for controlling the temperature of the thermal transfer media flowing through the chuck.

13. (withdrawn) A chuck for controlling a substrate temperature of a substrate on the chuck during processing of the substrate at a process energy, the chuck comprising:

a chuck surface having a face and a back side, the face of the chuck surface for receiving the substrate adjacent the chuck, the chuck surface having a high thermal conduction zone and a low thermal conduction zone, where the high thermal conduction zone of the chuck surface has a high thermal conductivity and is disposed adjacent a portion of the substrate that receives a greater degree of the process energy during the processing, and the low thermal conduction zone of the chuck surface has a low thermal conductivity and is disposed adjacent a portion of the substrate that receives a lesser degree of the process energy during the processing, and

a heat sink disposed adjacent the back side of the chuck surface for removing thermal energy from the chuck surface.

14. (withdrawn) The chuck of claim 13 wherein the chuck surface further comprises a ceramic material embedded with a filler material, where the ceramic material has a lower thermal conductivity than the filler material, and the filler material has a higher thermal conductivity than the ceramic material.

15. (withdrawn) The chuck of claim 14 wherein the ceramic material further comprises at least one of aluminum oxide and silicon oxide.

16. (withdrawn) The chuck of claim 14 wherein the filler material further comprises at least one of aluminum nitride, silicon carbide, beryllium oxide, and diamond.

17. (withdrawn) The chuck of claim 14 wherein the high thermal conduction zone of the surface of the chuck has a higher ratio of filler material to ceramic material than the low thermal conduction zone of the surface of the chuck, and the low thermal conduction zone of the surface of the chuck has a lower ratio of filler material to ceramic material than the high thermal conduction zone of the surface of the chuck.

18. (withdrawn) The chuck of claim 13 wherein the surface of the chuck has at least one intermediate thermal conduction zone, where each of the intermediate thermal conduction zones has a thermal conductivity that is between the thermal conductivity of the high thermal conduction zone and the thermal conductivity of the low thermal conduction zone, and each of the intermediate thermal conduction zones has a different thermal conductivity.

19. (withdrawn) The chuck of claim 13 wherein the high thermal conduction zone forms a circle in a center of the surface of the chuck and the low thermal conduction zone forms an annular ring around the high thermal conduction zone on the surface of the chuck.

20. (withdrawn) The chuck of claim 13 wherein the heat sink further comprises a flow chamber for receiving a temperature controlled fluid from a temperature controlled recirculator.